

OCR

Oxford Cambridge and RSA

An OCR endorsed
teaching and learning tool

OCR A Level

Computer Science

H446 – Paper 1



Structure of the Internet

Unit 5
Networks and web
technologies



PG ONLINE

Objectives

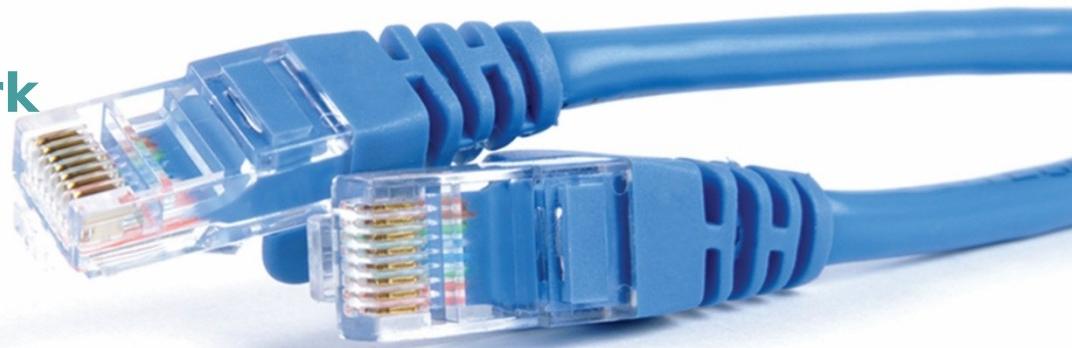
- Understand the structure of the Internet
- Describe the term ‘Uniform Resource Locator’ (URL) in the context of networking
- Explain the terms ‘domain name’ and ‘IP address’
- Describe how domain names are organised
- Understand the purpose and function of the Domain Name Server (DNS) system
- Describe the characteristics of LANs and WANs

Starter

- You access a website hosted in New York for a School called **Hill Top** from a computer in London
 - How does your request get there and back?
-
- How can the school in New York be distinguished from a school with the same name in the UK?

Connecting computers worldwide

- Computers communicate with each other using networks
 - The largest public network in the world is called the Internet but it is similar in concept to a network you would find at home
 - This is known as a **Wide Area Network** or WAN



The Internet

- The Internet is a network of **Inter**-connected **Networks**
- The World Wide Web is a collection of resources accessed via the Internet
 - The Internet can also be used to transmit data without using the web – how?



Directing traffic

- Similar to a road network, data traffic is directed to any location if the destination address is known

Structure of the Internet

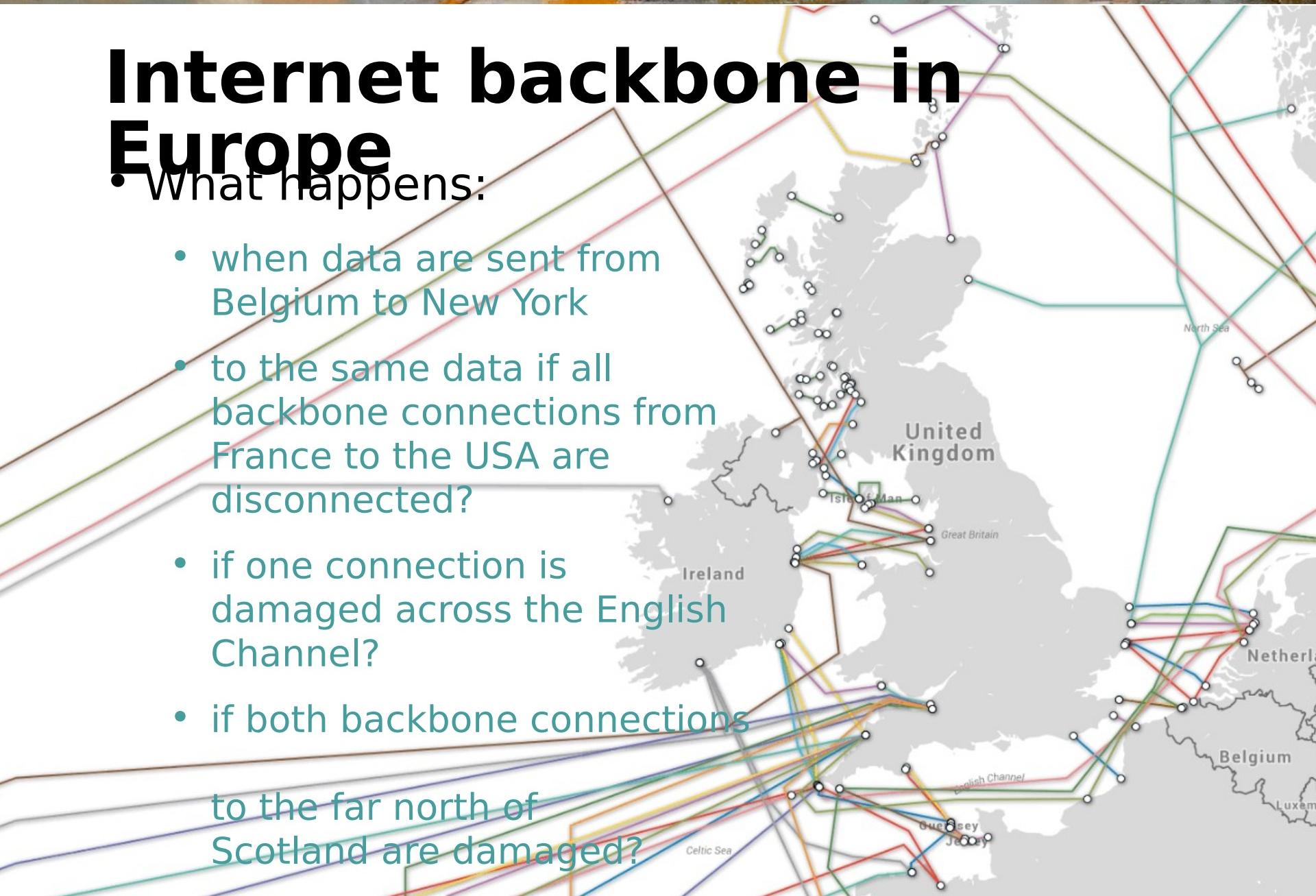
- The main part of the Internet is known as the backbone
- This is a set of dedicated connections that connect several large networks at various points on the globe
- Each of these points are then connected to other regional networks, usually controlled by Internet Service Providers (ISPs)
 - Which ISP do you use?
- An ISP provides access to individual end-users

Internet backbone in Europe

- What happens:

- when data are sent from Belgium to New York
- to the same data if all backbone connections from France to the USA are disconnected?
- if one connection is damaged across the English Channel?
- if both backbone connections

to the far north of Scotland are damaged?



Internet addresses

- Each device on a network needs to be uniquely identified so that data can be sent to the correct destination, much like an address on a letter
 - The Internet Protocol addressing system is used

14.132.250.10

IP addressing

- IP Version 4 (IPv4) addresses are made up of four octet values (numerical values described by 8 bits) each separated by a full-stop
 - **14.132.250.10** and **230.197.1.192** for example
 - This provides only 4.3 billion addresses for 6 billion people
- How many devices do you use personally?
 - There are no longer enough IPv4 addresses available - so Version 6 (IPv6) is used to extend this, giving enough for 340,282,366,920,938,463,463,374,607,431,768,211,456 separate addresses

Uniform Resource Locator

- URLs are used to specify the means of accessing a resource across a network and its location
- The protocol and the domain name of the resource together form the URL
- For example:
 - **http://** specifies that the resource requires http (a webpage)
 - **www.bbc.co.uk/index.html** is the fully qualified domain name and the name of the resource to be accessed (**index.html**)
 - The URL is a combination of these **http://www.bbc.co.uk/index.html**

Domain Name System (DNS)

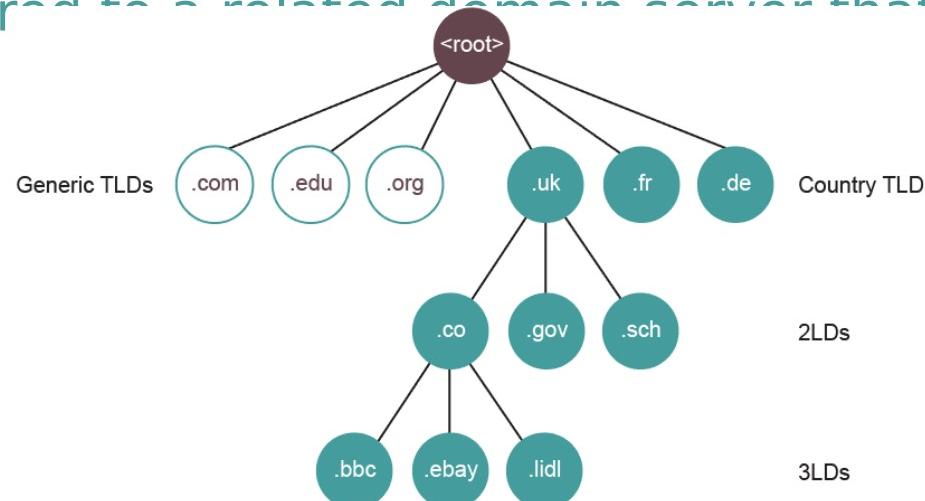
DNS servers are dedicated computers with an index of domain names and their corresponding IP addresses

- When a computer queries a DNS server for a domain name, the server returns an IP address that the computer can use to send a message to it
- Why do we not use IP addresses directly in a browser?
- Typing `google.co.uk` into a browser causes it to make a DNS request to return an IP address

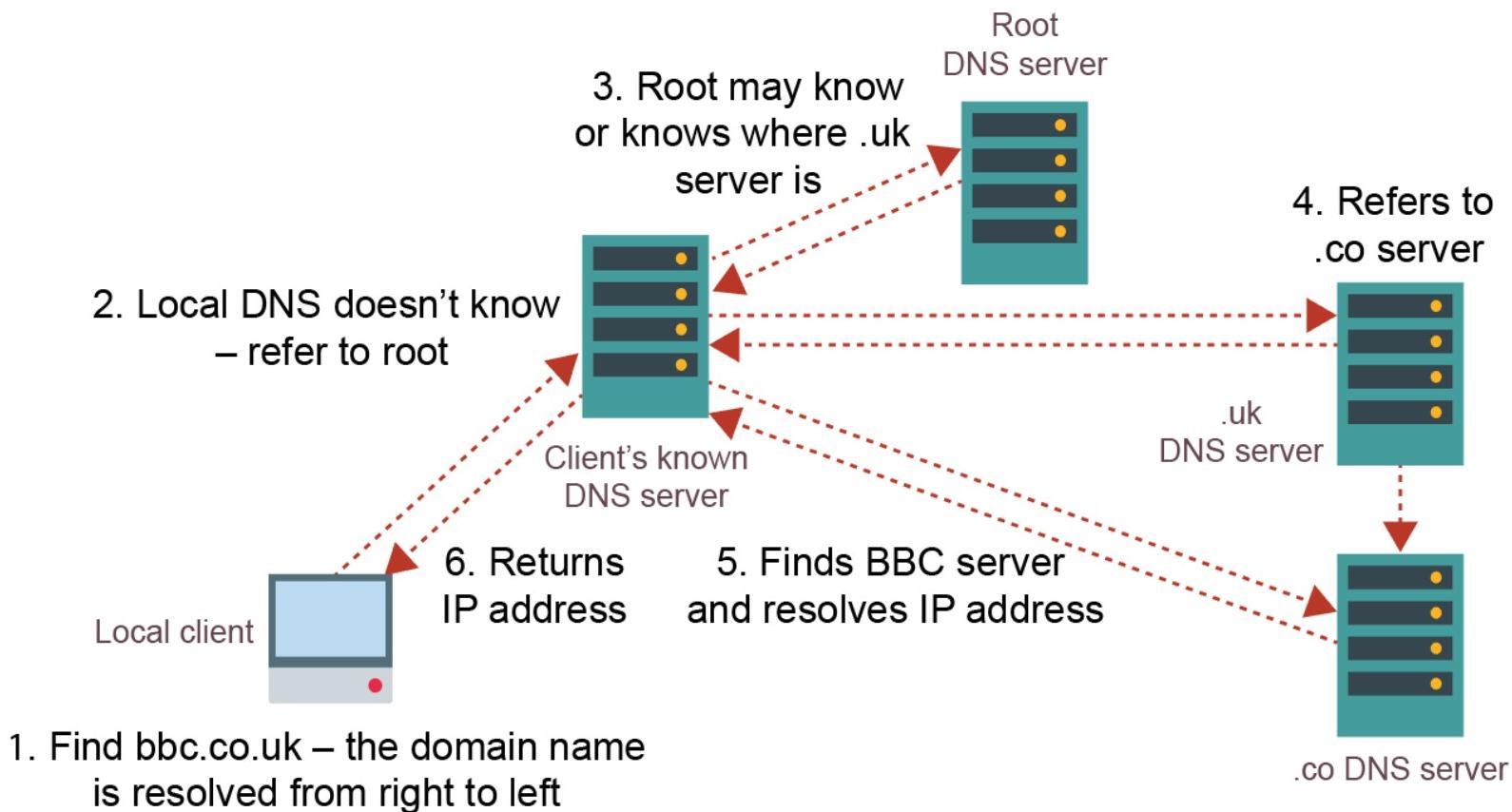
`www.google.co.uk` □
`216.58.209.99`

DNS server structure

- There are 13 root DNS servers that work together to catalogue every domain name
 - These are segmented into geographical groupings or levels
 - When the IP address of a given domain is not known it is referred to a related domain server that may know



Resolving an IP address



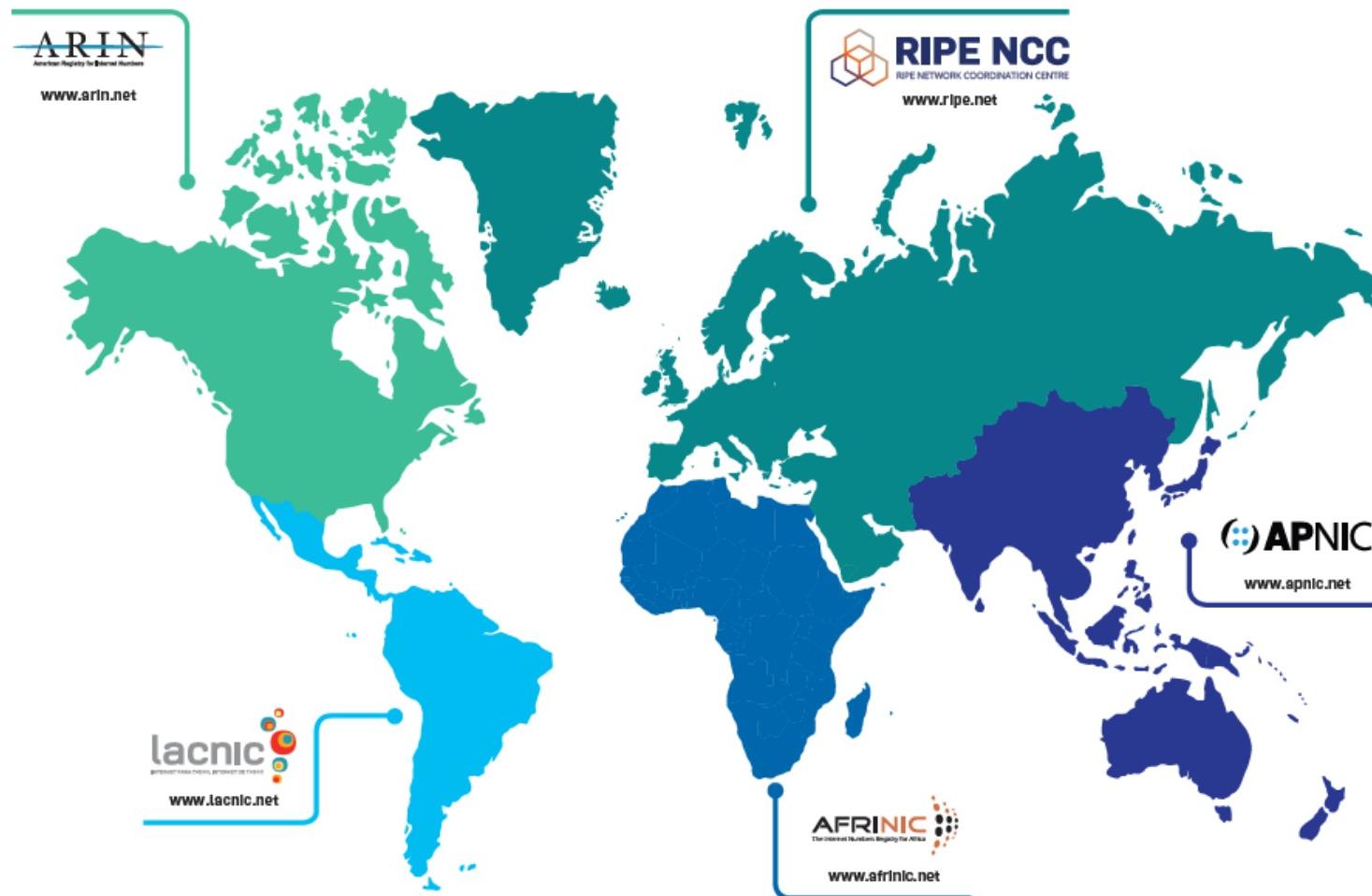
Resolving an IP address

- Suppose that a client has no cached record of an IP address for www.google.co.uk
 - It sends a DNS query for that domain to its specified DNS server
- If the DNS server does not have a record for that domain, it:
 - either recursively handles the request so that it can eventually deliver an IP address (or a “DNS address could not be found” error message),
 - refers to a DNS server authoritative for example, .uk and follows this, and subsequent referrals, to successively lower-level DNS servers

Internet registries

- Domain names must be unique otherwise DNS requests could be confused
- Five global Internet Registries are responsible for allocating IP addresses to specific domain names
 - These Registries work together to maintain a database of address assignments that ensure an IP is used once and domain names are distinct

Internet Registries



Purchasing a domain name

- Available domain names are issued by Internet registrars
- Use www.1and1.co.uk/domaincheck to check prices of domain names in the following Top Level Domains (TLDs)
 - .com
 - .uk
 - .net
 - .org

Worksheet 1

- Complete **Tasks 1 and 2**



Local Area Networks (LANs)

One computer, not connected to any other computing device is called a 'standalone'

- As soon as you connect two or more computers together they form a **network**

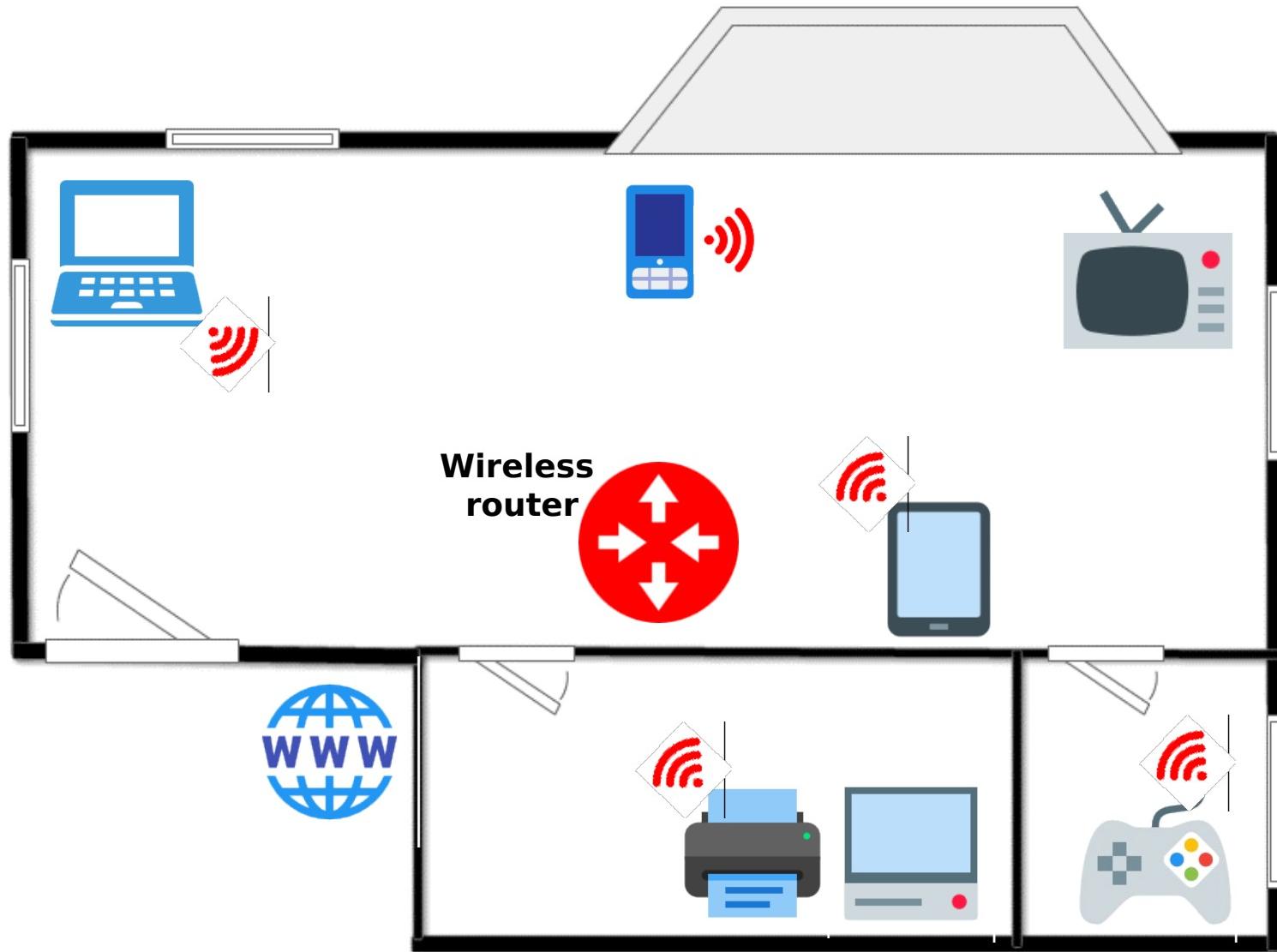


- All networks fall into one of two categories:
 - Local Area Network (LAN)
 - Wide Area Network (WAN)

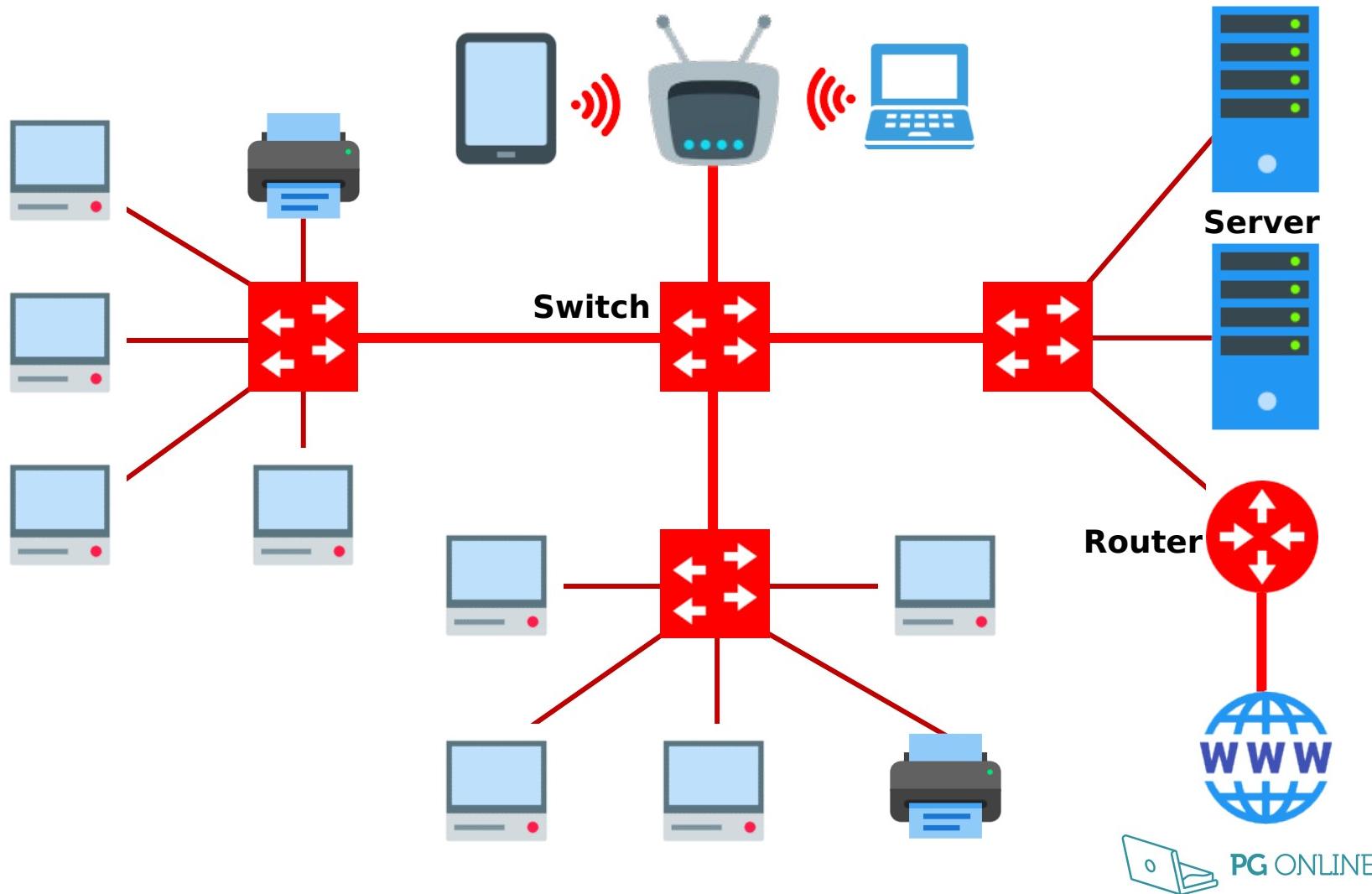
Structure of the Internet

Unit 5 Networks and web technologies

F



School Local Area Network



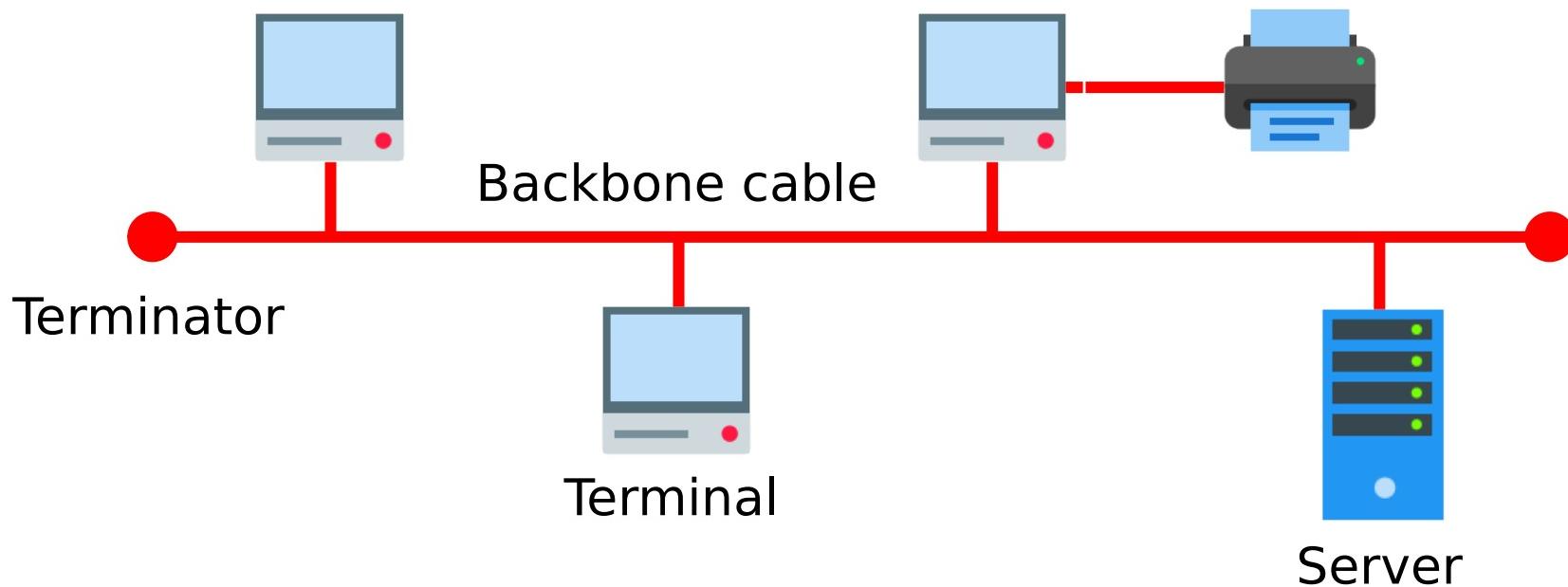
Local Area Networks (LANs)

- **Local Area Network:** two or more computers connected together within a small geographical area, for example confined to one building or site
 - Can you think of some obvious advantages of having computing devices connected in a **LAN**?

Network topologies

- A network topology is the arrangement of the various computing devices which make up a computer network
 - **Bus topology:** an arrangement where nodes are connected in a daisy chain by a single central communications channel
 - **Star topology:** an arrangement where a central node or hub provides a common connection point for all other nodes

Physical bus network topology



Operation of a bus network

- All nodes are connected to a single backbone cable
- Each end of the backbone is connected to either a terminator or a computer which stops signals ‘bouncing back’
- Each node is passive
- Data is sent in one direction at a time only
- Only one computer can transmit successfully at any one time

Bus network

- What are the advantages and disadvantages of a bus network?

Advantages

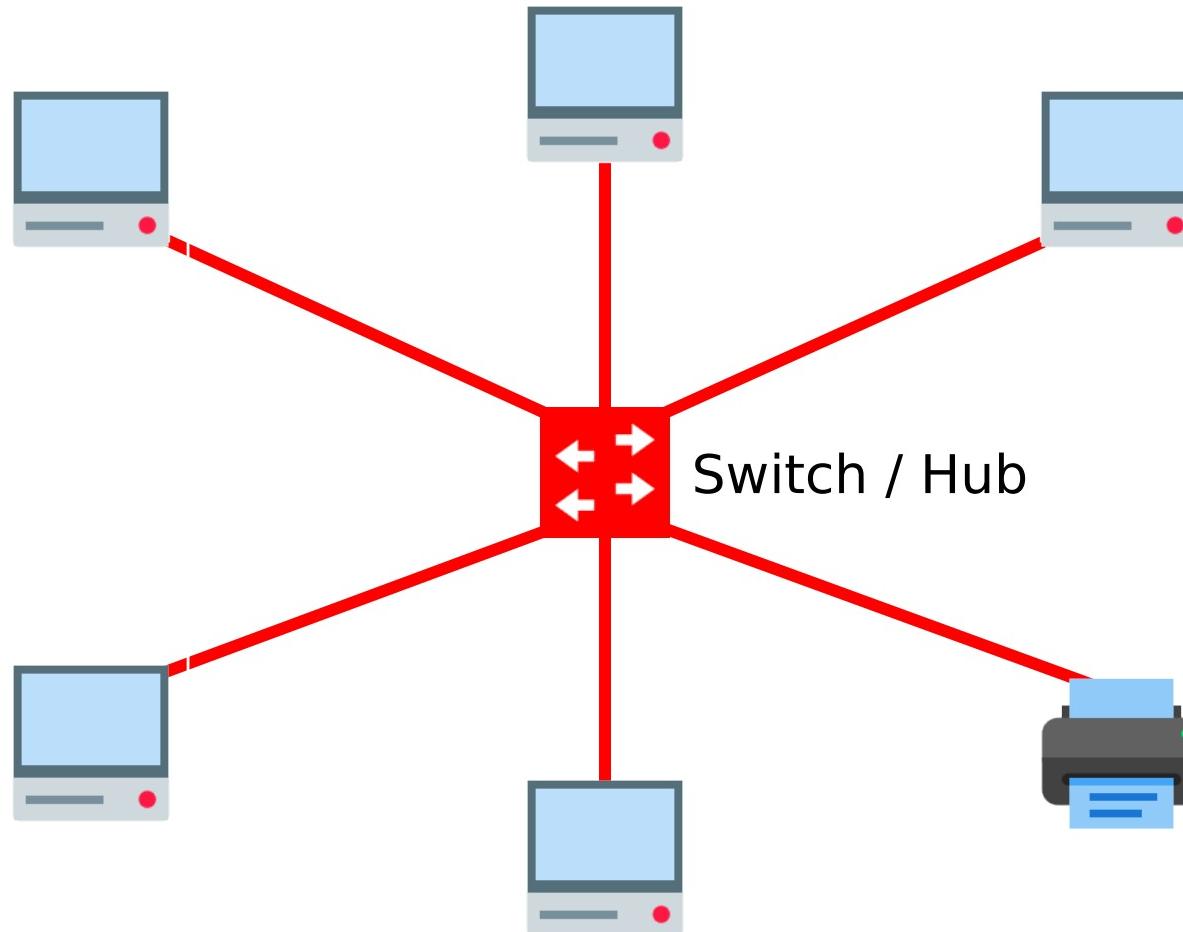
Disadvantages

Bus network

Advantages	Disadvantages
Inexpensive to set up	Main cable is a point of failure
Devices can easily be added	Limited cable length
Good for small networks	Performance degrades with heavy use, owing to data “collisions”
	Poor security



Physical star topology



Operation of a star network

- Computers are connected to a central node.
This is often a **switch**

- A **switch** sends each communication to the specific computer it is intended for



Star network

- What are the advantages and disadvantages of a star network?

Advantages

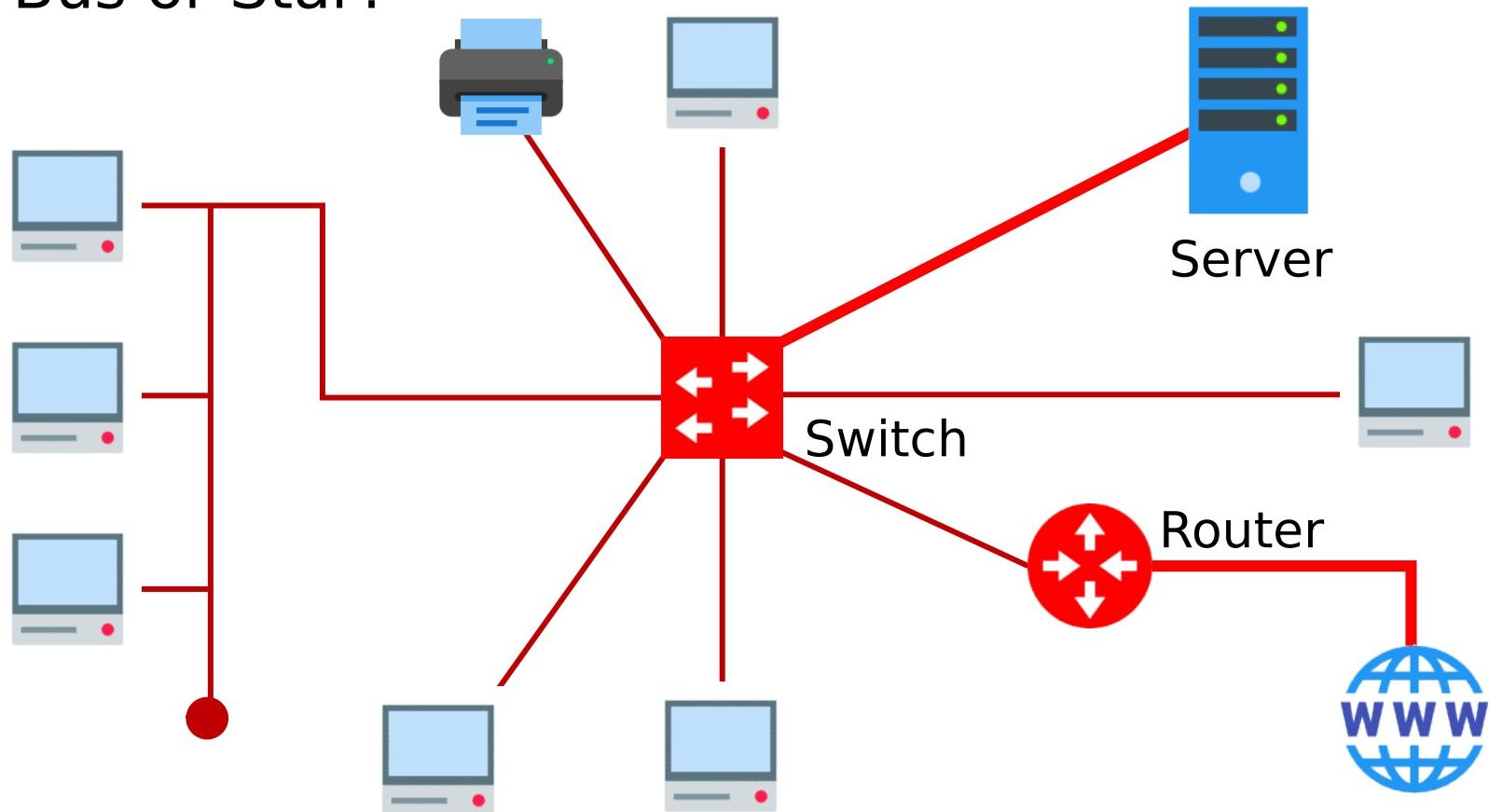
Disadvantages

Star network

Advantages	Disadvantages
Easy to isolate problems	Can be expensive to set up because of the length of cable required
Good performance	Central device is point of failure
More secure if a switch is used as data is sent only to the recipient	

Physical vs logical topology

- Bus or Star?



Physical vs logical topology

- The **physical** topology of a network defines how the devices are physically connected
- The **logical** topology defines how the devices communicate across the physical topologies
 - A network wired in star topology can behave logically as a bus network by using a bus protocol and appropriate physical switching

The purpose of Wi-Fi

- Wi-Fi is a wireless networking technology providing high-speed Internet and network connections
- Devices connect to the Internet via a Wireless network Access Point (WAP)
- Wi-Fi ‘hot spots’ can often be found in:
 - Cafes
 - Hotels
 - Libraries
 - Other public places

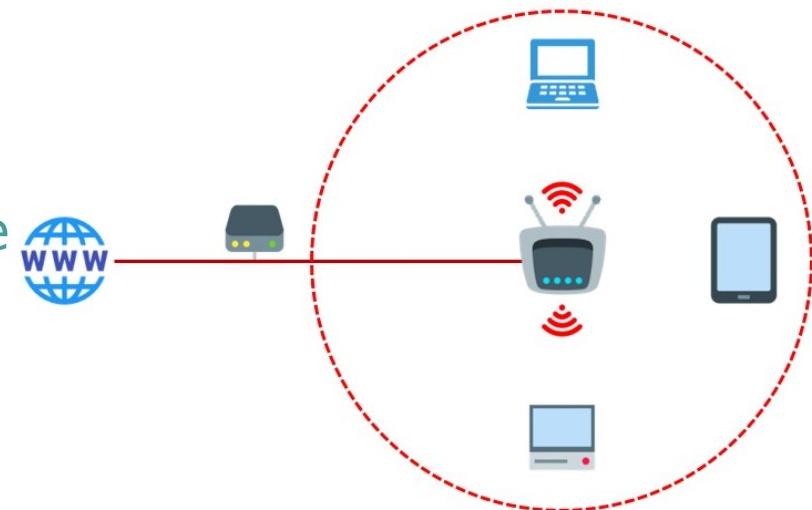


Wireless components

- Wireless Network Interface Card (NIC)
- A station consists of a computer and an NIC
- Stations share a radio frequency channel
- Wireless Access Point (WAP) requires a connection to a router, and the router requires a connection to a modem
 - The WAP and the modem are often built into the router

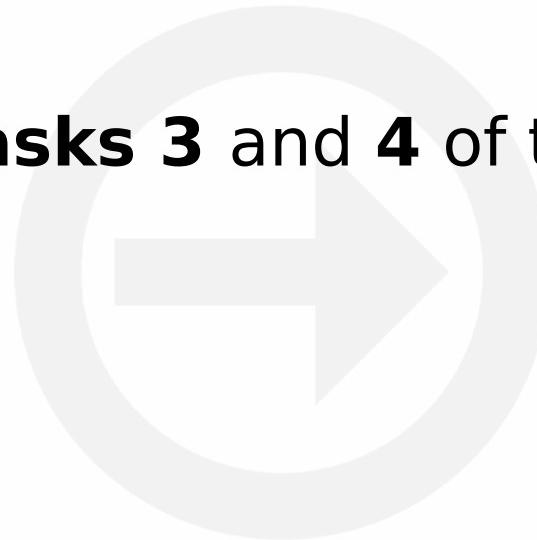
Connecting to a wireless network

- A wireless network requires a Wireless Access Point or WAP
 - This broadcasts on a fixed frequency
 - All devices within range can connect



Topologies

- Now do the questions in **Tasks 3 and 4** of the worksheet



Plenary

- Match the terms to their correct definitions:

Uniform Resource Locator

IP address

Domain Name System

Internet registry

Set of four numbers identifying a resource on a network

Organisations that control the allocation of domain names and IP addresses

A method by which hosts on a network can be identified by name based on groupings of addresses

The combination of the protocol and fully qualified domain name of a resource



Plenary Answers

- Match the terms to their correct definitions:

Uniform Resource Locator	Set of four numbers identifying a resource on a network
IP address	Organisations that control the allocation of domain names and IP addresses
Domain Name System	A method by which hosts on a network can be identified by name based on groupings of addresses
Internet registry	The combination of the protocol and fully qualified domain name of a resource



Copyright

© 2016 PG Online Limited

The contents of this unit are protected by copyright.

This unit and all the worksheets, PowerPoint presentations, teaching guides and other associated files distributed with it are supplied to you by PG Online Limited under licence and may be used and copied by you only in accordance with the terms of the licence. Except as expressly permitted by the licence, no part of the materials distributed with this unit may be used, reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic or otherwise, without the prior written permission of PG Online Limited.

Licence agreement

This is a legal agreement between you, the end user, and PG Online Limited. This unit and all the worksheets, PowerPoint presentations, teaching guides and other associated files distributed with it is licensed, not sold, to you by PG Online Limited for use under the terms of the licence.

The materials distributed with this unit may be freely copied and used by members of a single institution on a single site only. You are not permitted to share in any way any of the materials or part of the materials with any third party, including users on another site or individuals who are members of a separate institution. You acknowledge that the materials must remain with you, the licencing institution, and no part of the materials may be transferred to another institution. You also agree not to procure, authorise, encourage, facilitate or enable any third party to reproduce these materials in whole or in part without the prior permission of PG Online Limited.